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PATENT SPECIFICATION

415,657

Convention Date (United States): March 31, 1933.

Application Date (in United Kingdom): Feb. 19, 1934. No. 5425/34.

Complete Accepted: Aug. 30, 1934.

COMPLETE SPECIFICATION.

Ventilated Induction Motors.

We, CHICAGO PNEUMATIC TOOL COMPANY, of Chicago Pneumatic Building, 6, East 44th Street, New York, United States of America, (a company duly organized and incorporated under the laws of the State of New Jersey, United States of America), assignees of CHARLES BENJAMIN COATES, a citizen of the United States of America, of 1241 East 49th Street, Cleveland, Ohio, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to induction motors and has particular reference to the construction of a rotor of the built-up type in which the conductors and end rings are welded or brazed together.

An object of the invention is to provide circulation of air over the surfaces of the conductors or bars of the rotor. Another object is to increase the surface of the conductor in contact with the circulating air. A further object is to provide an improved cooling effect of the rotor and stator without impairing the operation of the motor or weakening the rotor structure. Other objects will appear more clearly from the description which follows.

The invention is embodied in an induction motor of the type having a rotor closely surrounded by the stator, the rotor having a laminated cylindrically-shaped core provided with a series of open slots around its periphery extending from end to end of the core, and a series of conductors in said slots with open trough or V-shaped passages therein extending throughout the length of the conductors and core. The invention is characterized by the provision of a fan or similar impeller means for drawing air through the passages in the conductors along the entire length thereof for cooling the latter. Each of the slots in the core comprises a main portion of considerable cross sectional area separated from the periphery of the core by a restricted portion, the conductor lying wholly within the main portion and the troughs communicating with the restricted portion of the slot. As a further improvement the motion of air along the surface of the conductors may be augmented by arranging the conductors spirally.

As a further development of the invention, the fan or impeller may be so constructed that it draws air through passages in the rotor and stator respectively, which passages are kept out of communication with each other. By separating the impeller mechanism for the stator from the impeller for the rotor, less difficulty is encountered in properly proportioning the areas of the respective passages to accomplish the desired flow of air through the rotor.

Referring to the drawings, Fig. 1 is a section of a motor embodying one form of the invention;

Fig. 2 is an isometric view of the rotor shown in Fig. 1;

Fig. 3 is a view in side elevation of one of the plates which make up the laminated core;

Fig. 4 is a detail sectional view showing part of a rotor of the form shown in Fig. 2;

Fig. 5 is a view similar to Fig. 4 but showing the conductor in a somewhat modified shape; and

Fig. 6 is a section similar to Fig. 1 but illustrating a modification of the fan and of the motor casing.

Referring to Fig. 1, a motor casing 10 of cylindrical form is provided at one end with an end plate 11, and at the other end with a closure 12. The end plate and closure are perforated at 13 to provide bearings for a rotor shaft 14. The motor proper comprises the rotor 15 keyed to the shaft 14, and the stator 16, which surrounds the rotor and is supported by the casing 10. At the opposite ends of the motor, air chambers 17 and 18 are provided, the former communicating with atmosphere through the ports 19 in the end plate. Adjacent to the air chamber 18 is situated the impeller or fan 20, keyed to the rotor shaft and being arranged to draw air from the chamber 18 and expel the same through ports 22 on the circumference of the casing. Suit-

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able passages 23 between the casing and stator provide a flow of cooling air over the stator core and windings. The rotor 15, as shown in Fig. 2, comprises a laminated core 25 each plate of which is perforated or otherwise cut away as indicated at 26 (Fig. 3) to receive the bars or windings 27 which extend beyond the full length of the core and terminate in end rings 28. Slots 29 extend from the perforations 26 to the periphery of the core plates. The end rings 28 are similar in cross-section to the core plates and receive the bars 27, the ends of the bars being flush with the plates. The conductor bars and end plates are preferably made of copper and are welded or brazed to each other. In accordance with the present invention the conductors do not occupy the entire area of the perforations 26 but are grooved to provide troughs or channels 31 in communication with slots 29 in the core plates and end rings. To illustrate the various possible forms these troughs may take, they are shown in Fig. 4 as V shaped and in Fig. 5 as substantially U shaped. The high conductivity of the copper permits of a large area of the troughs without making the resistance of the conductors too high. The bars 27 and consequently the perforations 26 are regularly spaced about the circumference of the core and while they are illustrated as being somewhat spiralled, they may be straight, if so desired.

In operation, the fan draws air from one end of the rotor along the slots 29 and troughs 31 to the other end of the rotor. It will be readily apparent that the moving air is in contact with the copper bars over a large area, and that the additional area provided by the slots 29 increases the circulation of air. Furthermore, the rotation of the rotor has the effect of an air screw in augmenting the flow of air through the spiral grooves. The direction of the spiral formed by the copper bars and of the blades of the fan, is preferably such that the air is drawn through the ports 19 into the chamber 17, forced through the troughs and slots of the rotor into the air chamber 18 from whence the air is drawn or removed by the fan. The latter, at the same time draws air through passages 23 for the stator.

In the embodiment of the invention shown in Fig. 6, the construction is the same as in Fig. 1 except as to the fan and casing. Consequently description of Fig. 6 will be limited to these features. The modified fan 36 comprises two sets of blades 37 and 38 separated from each other by a plate 39. This plate is provided with a skirt 40 which extends into the air chamber 18 and terminates just short of the end ring 28 of the rotor. The skirt 40 is at least equal in diameter to the rotor and provides therewithin a passage leading from the rotor to the fan blades 37. The inside area of the skirt 40 is out of communication with passage 41 leading from the stator to the fan blades 38. As a result of this construction, the passages 23 extending between the stator and casing may be made as large as desired without reducing the pressure difference between the ends of the rotor.

As an additional or alternative means of properly proportioning the air between the stator and rotor passages, respectively, the casing 10 may be provided with an inwardly projecting annular flange 43 which deflects the incoming air toward the passages in the rotor, partially at the expense of circulation through the stator passages 23.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An induction motor comprising a stator, a rotor surrounded by said stator, said rotor having a laminated cylindrically shaped core provided with a series of open slots around its periphery extending from end to end of the core, a series of conductors in said slots with open trough or V-shaped passages therein extending throughout the length of the conductors and core, characterized by the provision of a fan or similar impeller means for drawing air through the passages in said conductors along the entire length thereof for cooling the latter.

2. An induction motor according to claim 1 or claim 2 characterized in that each of the slots in said core comprises a main portion of considerable cross-sectional area separated from the periphery of the core by a restricted portion and the conductor lies wholly within the main portion, the trough in said conductor communicating with said restricted portion of the slot.

3. An induction motor according to any or all of the preceding claims characterized in that said slots, conductors and passages are arranged spirally in the core in such direction that rotation of the core forces the air through the passages thereby supplementing the action of the impeller.

4. An induction motor according to any or all of the preceding claims in which the stator has cooling passages paralleling the passages in the rotor, characterized in that the fan or impeller is partitioned to provide separate currents of air for the

rotor and stator passages respectively.

5. An induction motor according to claim 4 characterized in that the motor casing is provided with means to deflect incoming air from the stator passages to the rotor passages.

6. An induction motor substantially as described.

Dated the 19th day of February, 1934.

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Chartered Patent Agents.

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Fig. 1

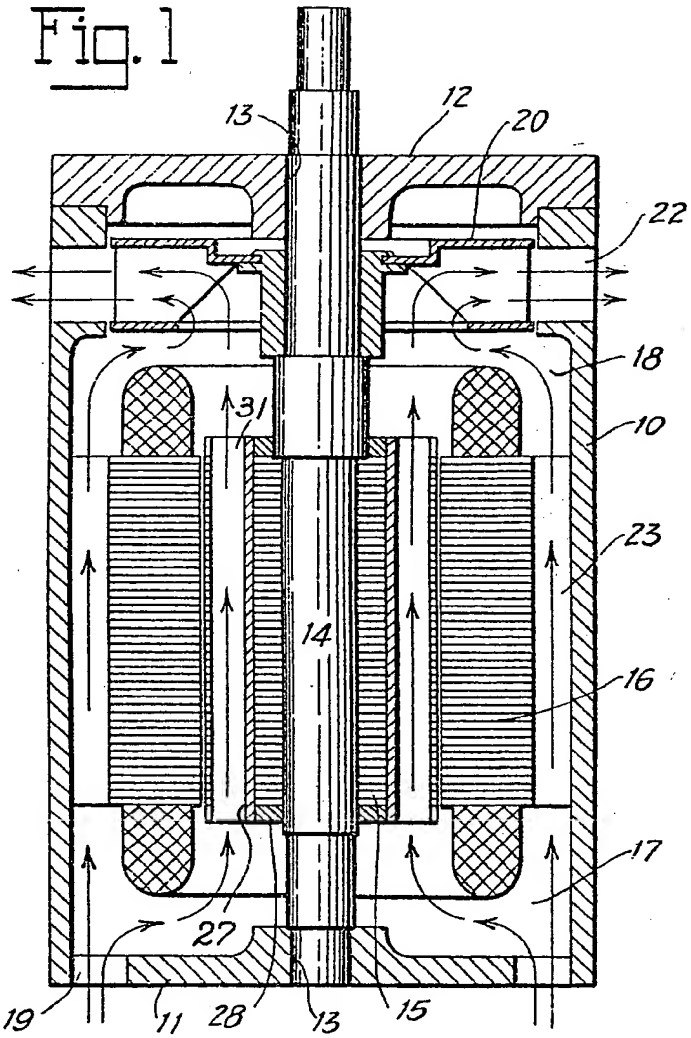


Fig. 2

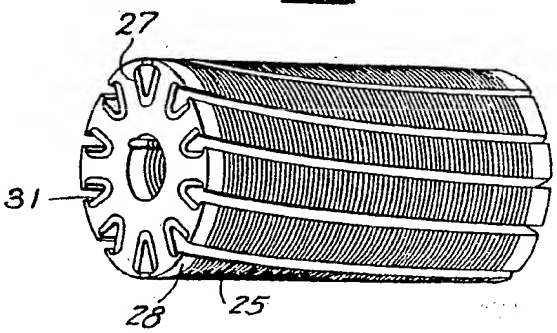


Fig. 3

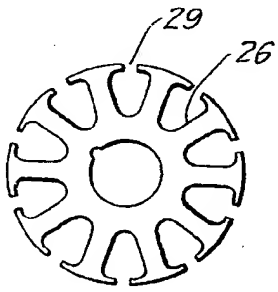


Fig. 4

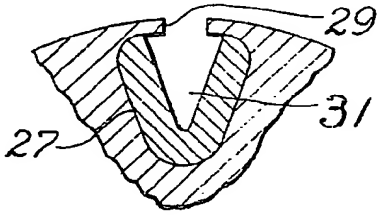


Fig. 5

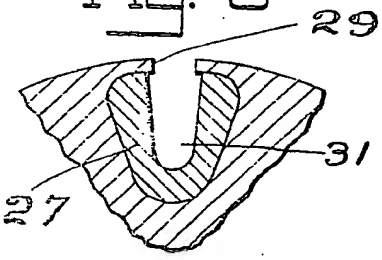
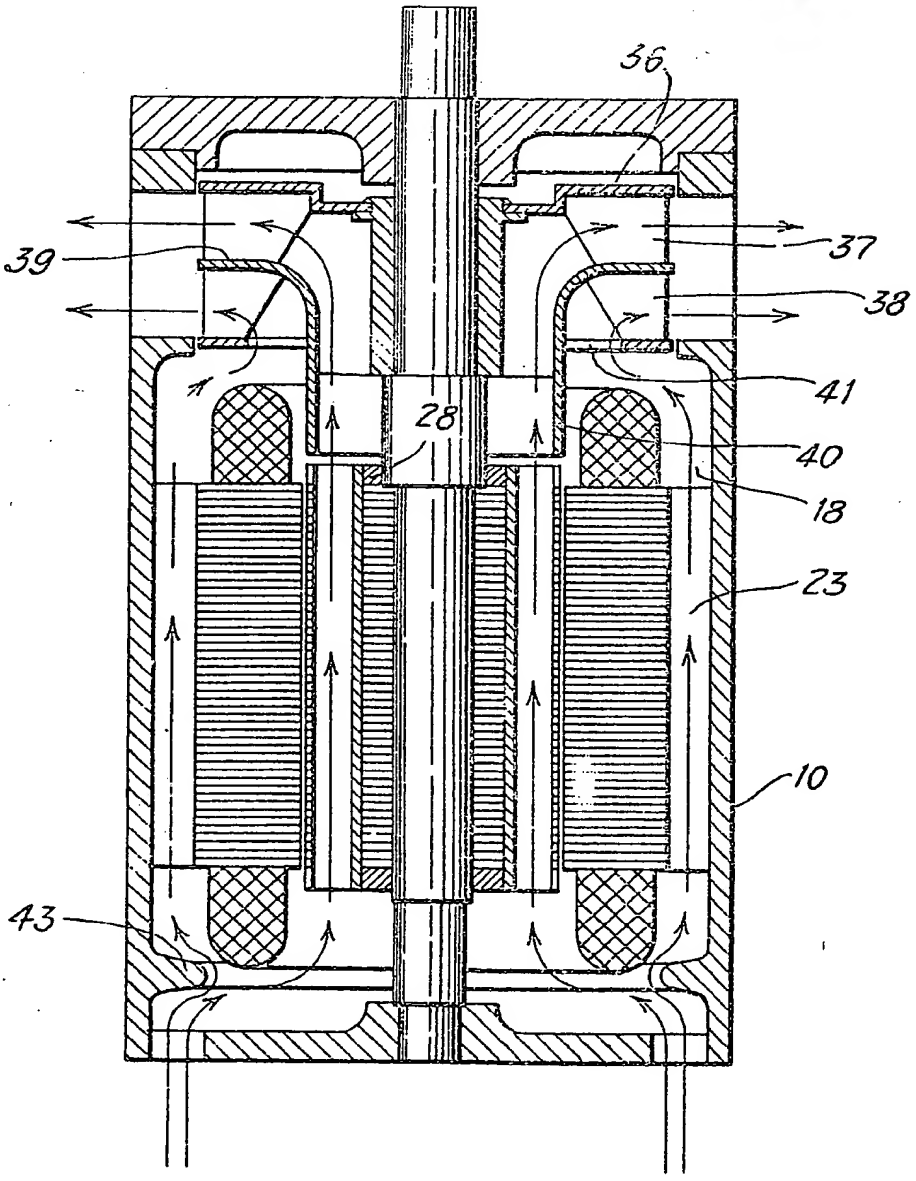


Fig. 6



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415,657 COMPLETE SPECIFICATION

Fig. 1

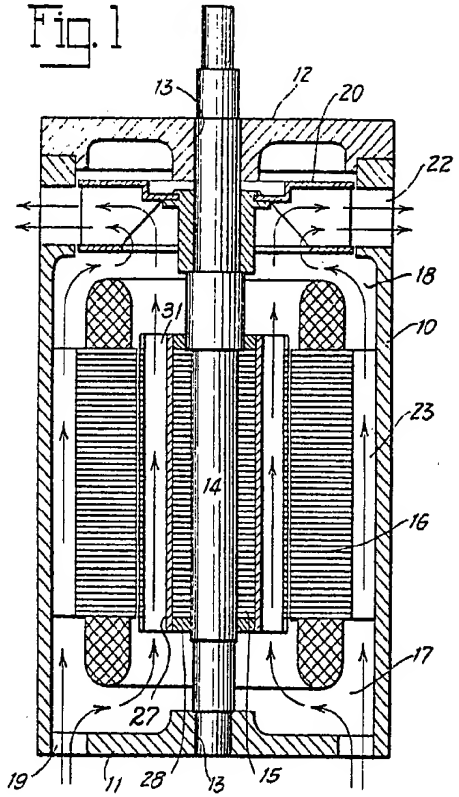


Fig. 2

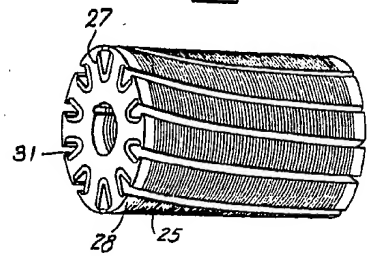


Fig. 3

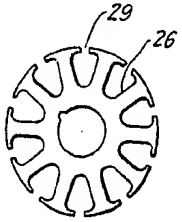


Fig. 4

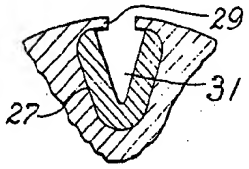


Fig. 5

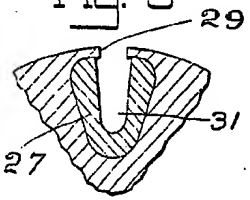
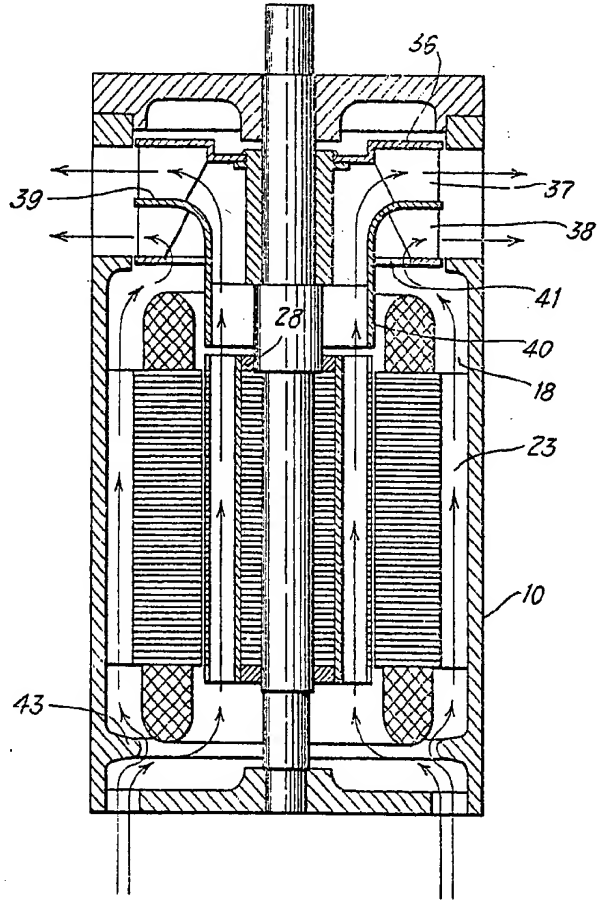


Fig. 6



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